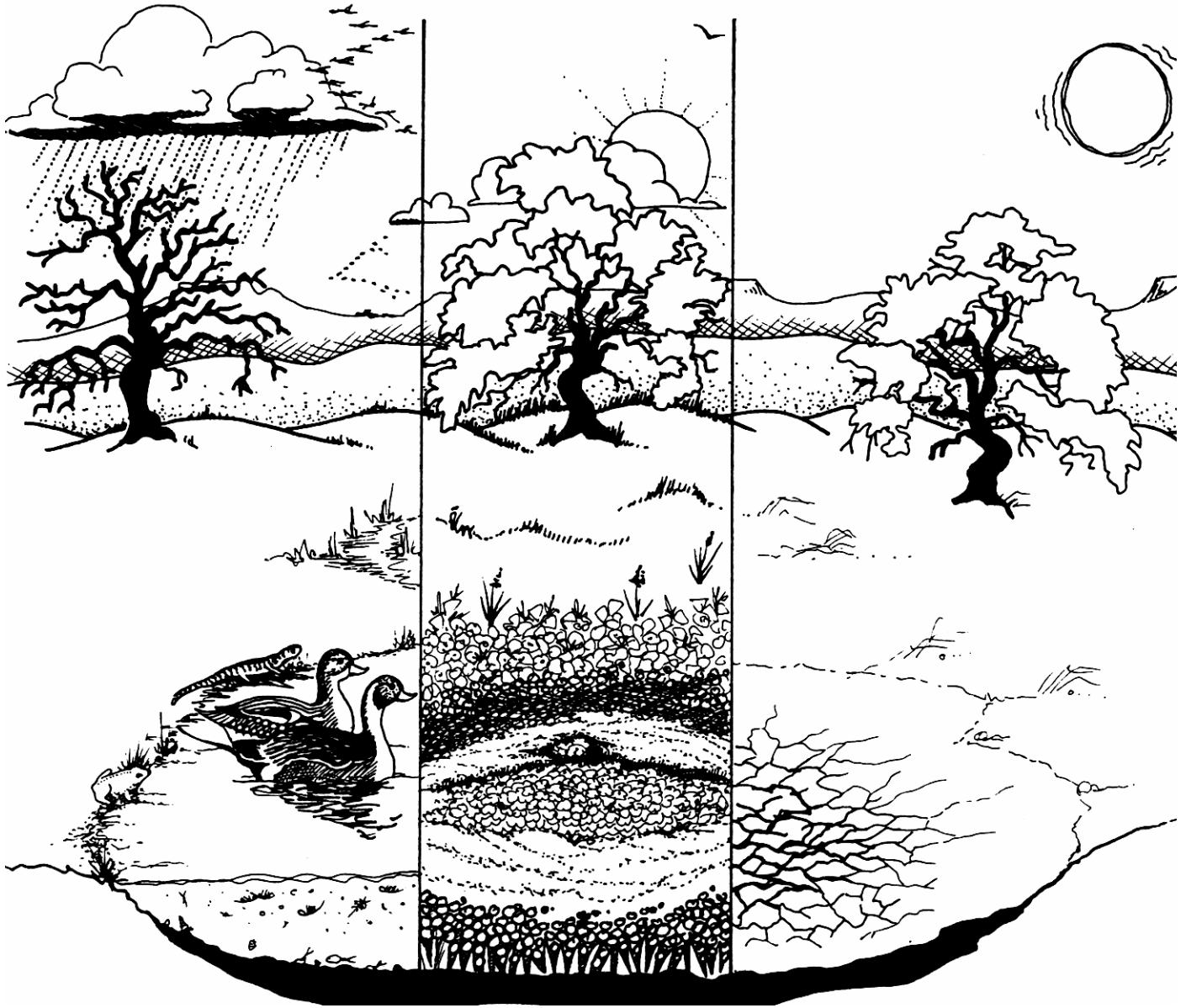


Seasons and Vernal Pools



Winter

Invertebrates hatch and spadefoot toads mate as rain fills the pool. Egrets, ducks, hawks, and amphibians dine on the bugs.

Spring

Tiny wildflowers bloom as the pool recedes. Invertebrate eggs settle into the mud. Baby toads stock up on bugs, then burrow themselves deep until the next rainy season.

Summer

The pools are dry. Eggs, cysts, and seeds lie dormant until winter returns.

Seasons and Vernal Pools.....

What are vernal pools? Vernal pools are a type of wetland, but they are very different from the familiar wetland marsh or swamp. Vernal pools usually are found in the gently sloping plain of grassland. Although similar pools occur elsewhere in the world, the vernal pools of California are distinctive. They are characterized by the uniqueness of the species they support, some of which are found nowhere else on earth. California's vernal pools have been called one of the world's rarest ecosystems. Most of California's vernal pools lie on the east side of the Great Central Valley but they also occur on raised marine terraces near San Diego, on the Santa Rosa Plateau, and in several Coast Range valleys.

When rain falls on vernal pool grassland, some water sinks into the ground and the rest flows slowly over the land, this flow is called run-off. Run-off flows to the lowest places (depressions) and forms vernal pools. The water cannot move deeper into the ground because the hardpan blocks its path. Hardpan is a layer of clay or minerals that water cannot pass through easily. The hardpan can be a few inches to a few feet below the ground surface. The hardpan acts like a bath tub holding in the water. The only way for the pools to empty is by very slow movement of water through the ground or by evaporation. Vernal pools vary in size; some are bigger than a playground while others are smaller than a classroom.

There are three phases or seasons for the vernal pool ecosystem; winter-the wet phase, spring- the flower phase, and summer/fall – the dry phase then the cycle begins again.

As soon as winter rains begin to puddle in the vernal pools, tiny creatures called bacteria and protozoa appear and begin feeding on detritus, bits of dead plants and animals that lie on the bottom of the pool. These detritus feeders are, in turn, eaten by many other species. Soon algae, microscopic green

plants appear. The water signals eggs, cysts and spores of dormant aquatic life to hatch and grow. Within a few weeks, species of invertebrates (small animals without backbones) will be living in the pools. Soon frogs, snakes, birds, and mammals come to the vernal pools for dinner. The food web connects all the species in the vernal pool grassland ecosystem. They depend on each other to make life possible.

Spring is a beautiful time to visit vernal pool grassland. Vernal pools actually are named for spring because “vernal” means “spring” in Latin. Plant seeds sprout and grow in the muddy soil. Over 200 plant species can grow in vernal pools, 60 of these are endemic to vernal pools, and this means they grow only in vernal pools and nowhere else. The plants grow quickly along the shrinking edge of the water. The flowers make colorful rings around the outside of the pools. The display of wildflowers changes from week to week. Vernal pools are like snowflakes in that no two are exactly alike. Plants select their host pools based on the growing conditions they offer.

By the beginning of summer, soil in the bottom of vernal pools crack and dry. Plants turn brown and aquatic life dies or leaves the pools. Many of the critters are gone; however they leave behind the eggs, cysts, spores and seeds that will carry the genes of their species through the long, hot summer. Each species has a way to survive; adapted to live in this ecosystem. Even though the vernal pool looks dry and barren it continues to support many species through summer and fall. Seeds provide food for insects, birds, and rodents. Rodents are food for hawks and coyotes. Toads and frogs use rodent burrows for shelter while snakes slither through the dry grass looking for dinner. The food web connects species even when this wetland isn't wet. In the dryness of fall, it is hard to imagine that soon winter rains will fill the pools and the life cycle of hundreds of species will begin again.

Seasons and Vernal Pools Activity

Objective

Students will construct a food web.

Method

Students read about the vernal pool habitat and participate in constructing a food web as a classroom activity.

California Content Standards - 4th grade

Language Arts

Reading 1.0; 2.4; Listening 1.1, 1.2

History-Social Science - 4.1

Science

Life Science 2a,b,c; 3a,b,c,d

Materials

White board or chalkboard or easel pad, one copy per student of *Seasons and Vernal Pools*. A map of California

Procedure

1. Have students read *Seasons and Vernal Pools*.

Have students view a map of the state and identify the areas where most of California's vernal pools occur. Discuss characteristics of the locations and the physical environments.

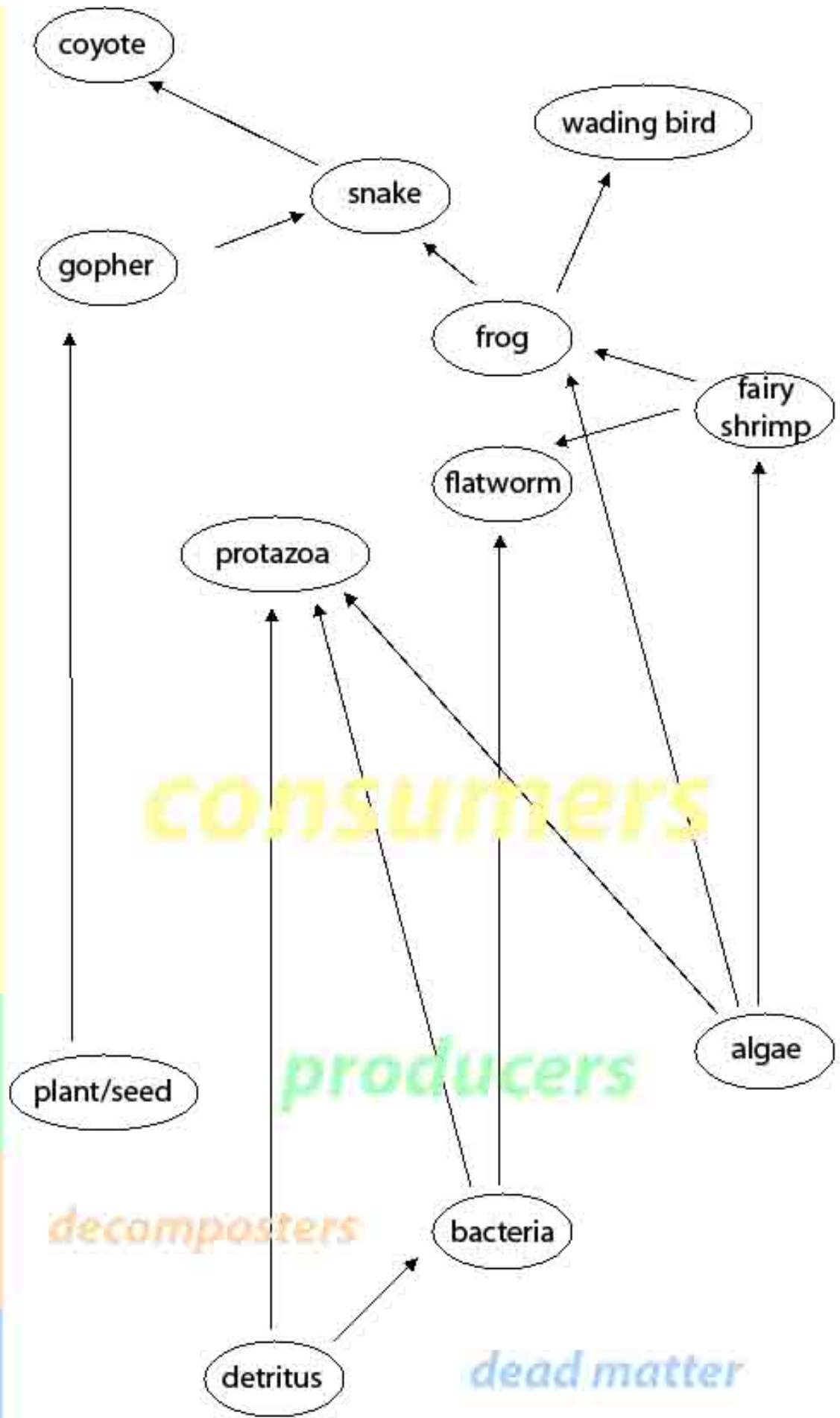
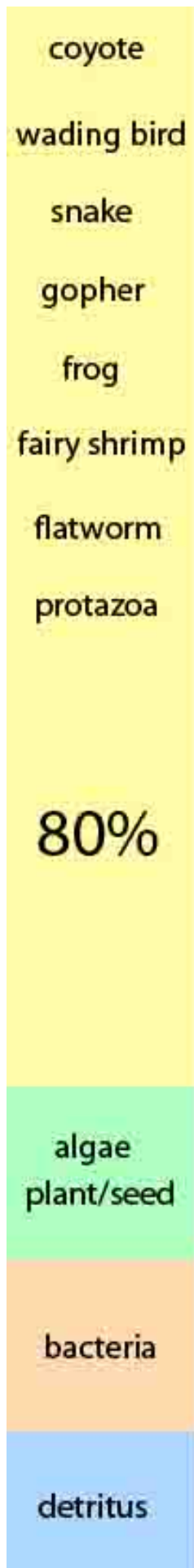
2. Discuss the fact that even with seasonal changes, the vernal pool provides food and shelter for many species.
3. Define a food web (the network of organisms in an ecosystem that moves food energy from producers [plants] through several layers of consumers [animals]). Have students suggest species that maybe part of a vernal pool food web. Create a list of the species suggestions.
4. Explain that the class will work together to create a vernal pool food web.
 - On the board or large sheet of paper create four horizontal sections. Label the sections from the bottom up: dead plant and animal matter, decomposers, producers, and consumers. The consumers section needs to be 80% of the space (see *Food Web* example).

- Ask students the name for the dead plant and animal matter, and write **detritus** in that section.
- Ask if anyone remembers the name of the decomposers, and write **bacteria**.
- Producer is the name given for plants because they produce their own food. Write **plants & seeds** in the third sections, ask if anyone remembers the name of another producer, and write algae in this section.

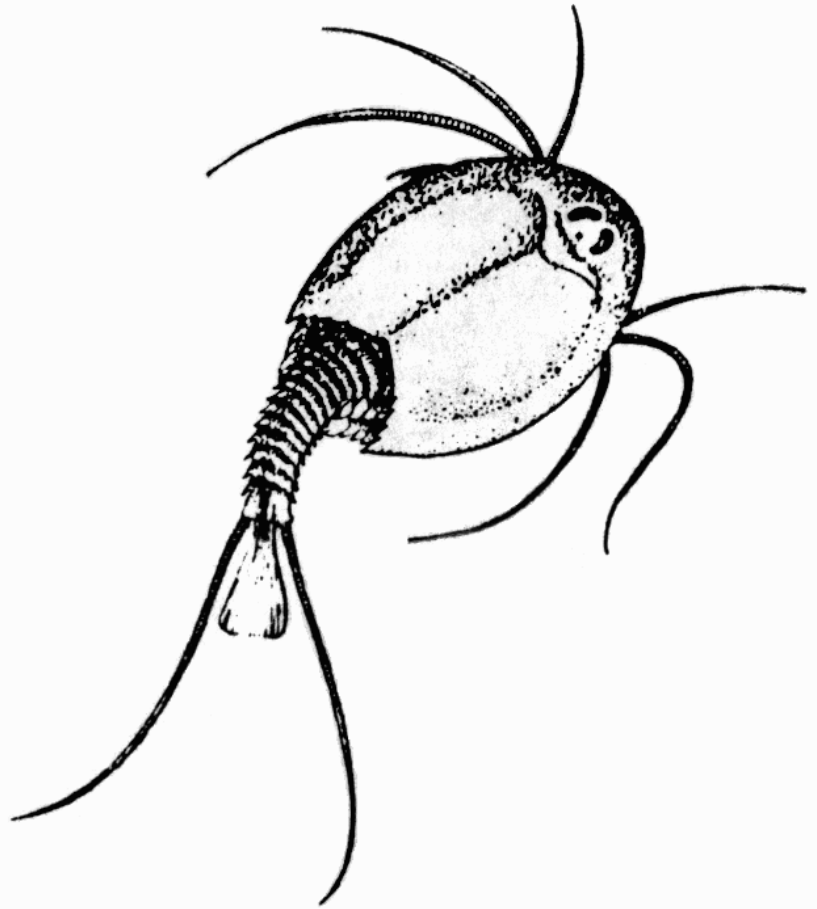
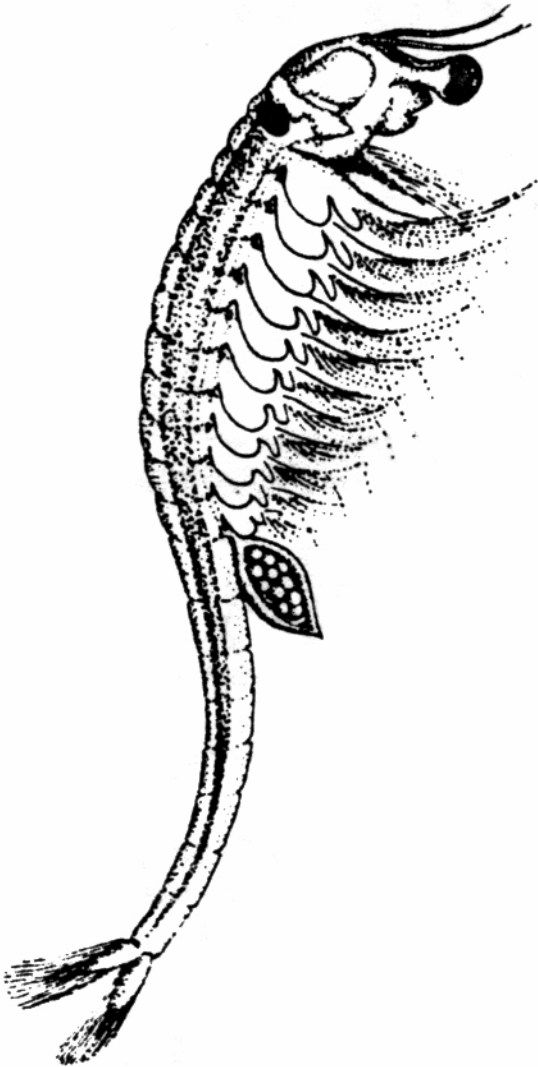
5. Explain that the consumer section will be filled in with the species from the student's suggestion list. However they will be added in the order of who eats whom. Provide students with an example, like algae is eaten by a mosquito. From the class' list, who eats mosquitoes?
 - Since this is to be a food web rather than a food chain, there maybe more then one species consuming the same food source. Algae, plants, and seeds provide food for many species and in turn they are eaten by a large variety of consumers.
 - Have students take turns adding species to the food web. Add a directional arrow from food source to consumer.
 - Continue until all the species are part of the web. During the process students may think of other species that they would like to include.
6. Invite students to make their own food web.

Evaluation/Extension

1. Explain that a pesticide in runoff has gone into the vernal pool and killed all the algae. Have students identify the organisms that would be affected.
2. Reflect on the value of keeping water clean for aquatic life.
3. Remove other species from the web, one at a time. How is the food web altered? Discuss the importance of each species after several species have been removed.



Meet two interesting endangered vernal pool critters, the Fairy shrimp and the Tadpole shrimp!



Fairy shrimp usually grow to about one inch in length. They have delicate long bodies, large eyes, and 11 pairs of legs. By fanning these legs in a wave-like motion, they gracefully swim or glide upside down. Fairy shrimp feed on smaller animals, algae, bacteria, and detritus. In turn, fairy shrimp may be eaten by tadpole shrimp or birds such as egrets and ducks. Fairy shrimp eggs (called cysts) are extremely hearty, able to survive heat, drought and frost until rains return. Some species of fairy shrimp have survived for 50 million years. Scientists have found cysts over 100 years old, which were put in water and hatched.

Tadpole shrimp are interesting animals reaching a length of about two inches. They have about 35 pairs of legs and a large shield-like structure that covers most of the body. Tadpole shrimp often plow along in bottom sediments, causing pool water to become cloudy. They feed on detritus and small animals like fairy shrimp. Eggs are deposited on vegetation and other objects on the pool bottom. The adults die but the eggs survive the dry months and hatch when rain returns.